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Some observations on the biology of the Australian butterfly *Acraea andromacha andromacha* (Fabricius)

(Lepidoptera, Nymphalidae)

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A new larval host plant, *Passiflora suberosa* L. (Passifloraceae) is recorded for the Australian butterfly, *Acraea andromacha andromacha* (Fabricius) (Nymphalidae), from Brisbane, south-east Queensland, Australia. Field observations have shown that this butterlfy develops normally to adulthood on this host plant. Eggs laid by females in the field on *P. suberosa* were counted, and they ranged from 14–122 eggs per batch (mean = 50.2 ± 31.8). Female pupae tend to be larger than those of the males, resulting in larger adults. The male pupal duration is slightly longer (8.9 ± 0.4 days; range 8.5–9.3 days) than that of the female pupae (8.6 ± 0.8 days; range 7.5–10.5 days). Most adults of both sexes emerged from the chrysalis during early morning (2400–0400 hrs). The fly *Winthemia neowinthemioides* (Townsend) (Tachinidae) is recorded as a parasite, and the spiders *Thomisus spectabilis* Doleschall (Thomisidae) and *Nephila edulis* Koch (Argiopidae) are recorded as predators of *A. andromacha*, for the first time.

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Introduction

Acraea andromacha andromacha (Fabricius), commonly known as the Glasswing, is widely distributed in northern and eastern Australia and is one of the most common Australian butterflies. It was one of the first insects described from Australia, having been collected by the naturalists of the Endeavour expedition in 1770 and named by J. C. Fabricius in 1775. The species is the only member of the subfamily Acraeinae in Australia. The adults are very distinctive in colour pattern; the forewing is almost transparent (hence the common vernacular name) with a few dark brown spots; the hindwing is white or cream in colour with black spots, while the termen is broadly black with a series of small white subterminal spots. Females may be distinguished from males by the presence of a large, dark, shiny plate surrounding the ostium near the tip of the abdomen, which after mating, is blocked by a clearly observed, stiff brown sphragis, deposited by the male (Common & Waterhouse, 1981). Despite this butterfly having a very widespread distribution in Australia and its great abundance in many areas, little has been recorded on the general biology of *A. andromacha* apart from brief descriptions of the life-stages and a list of known larval host plants (e. g. Common & Waterhouse, 1981). Opportunity arose during 1984–85 to study some aspects of the biology of this butterfly and the results are recorded and discussed here for the first time.

Materials and methods

Observations on *A. andromacha* were undertaken during 23 December 1984 to 15 January 1985, both in the field and in the laboratory. Eggs were counted on the leaves of the host plant in the area, *Passiflora suberosa* L. and larvae of all stages were observed during this time. Several last instar larvae were reared in the laboratory to pupae and then successfully to adults and the data obtained forms the main discussion of this paper. In the laboratory, the pupae were measured and numbered while the sex and length of the forewing (as measured along the front margin), and body length of the newly emerged adults were also recorded. The duration of the pupal stage for each butterfly was also determined by recording the times of pupation and of adult emergence and determining the difference.

The study site was situated in the Brisbane suburb of Highgate Hill, in an artificial (i. e. largely human-induced) rainforest-like habitat between minor roads and housing developments. The larval host plant, *P. suberosa* was common in some areas of the site, growing vigorously amongst other weeds and shrubs. *P. suberosa* is a variable, twining plant with trifid leaves and small greenish flowers which later develop into dark green and purple berries measuring about 10 mm in diameter; it is a native of southern United States, Mexico, West Indies and Central and South America; it is widely occurring in disturbed habitats in the Brisbane area.

Results

Egg. (Fig. 1). Generally, eggs of this species were scarce and difficult to locate amongst the vegetation. Despite this problem, nine batches of eggs were encountered on the foliage of *P. suberosa* during the study periods. The batches contained 14, 26, 30, 39, 44, 46, 63, 68 & 122 eggs respectively (mean = 50.2, S. D. = 31.8). Many of the batches were found to be composed of freshly laid eggs. (The eggs are bright yellow when first laid and change gradually to an olive colour prior to the larvae emerging). In most cases, batches were laid on the adaxial (upper) leaf surfaces, especially near the leaf margins.

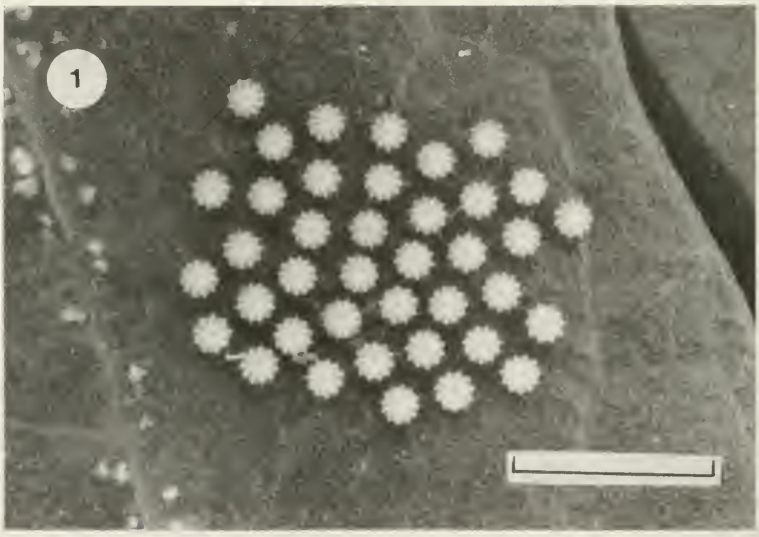

Fig. 1. One freshly laid batch of eggs of *Acraea andromacha andromacha* (Fabricius) on the upper (adaxial) surface of a *Passiflora suberosa* L. leaf at Brisbane, south-eastern Queensland. (Scale line = 5 mm).

On one occasion, a female *A. andromacha* was observed laying eggs on a fresh leaf; the resulting batch of 39 eggs was collected and photographed (Fig. 1). The developing first stadia larvae took 4–5 days to hatch from the eggs.

Fig. 2. Early instar larvae (first and second instars) of *A. andromacha* (Fabricius) on the fresh leaves of *Passiflora suberosa* L. hatched from field-collected eggs, in the laboratory. (Scale line = 3 mm).

Larva and pupa. Early instar larvae (Fig. 2) were rarely observed in the field. In the laboratory, the first and second instar larvae fed voraciously on fresh, new foliage of *P. suberosa,* but high mortality was observed in third and fourth instar larvae, resulting in very few last (fifth) instar larvae (Fig. 3) being produced. The scarcity of final instar larvae was also evident in the field. A total of 18 final instar larvae were collected from the field, of which 14 were successfully reared to the pupal stage (Table 1). The last instar larvae rested motionless for 0.75 to 1.0 day on a leaf or twig before undergoing ecdysis, which took only 2–4 minutes. During the quiescent stage, larvae often exuded a pale blue-purple droplet of liquid from the posterior end of the body when disturbed; the droplet usually collected on one of the cuticular spines (Fig. 4).

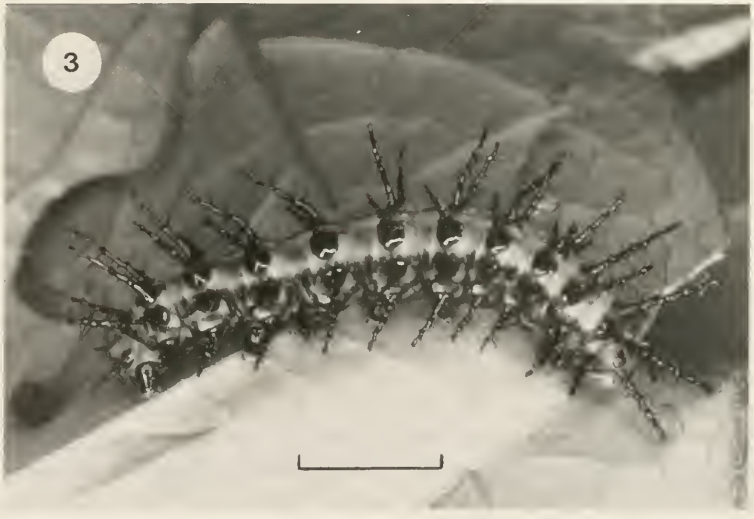

Fig. 3. Last (fifth) instar larva of *A. andromacha* (Fabricius) from a fresh leaf of *Passiflora suberosa* L. in the laboratory. (Scale line = 5 mm).

The pupa (Fig. 5) takes about 2–4 hours to reach full coloration and sclerotization. The male pupae were generally smaller than those of the female; male pupae ranged from 18.0 to 20.0 mm long and 5.4 to 5.6 mm wide (measured at the widest point on the abdomen), while female pupae ranged from 19.0 to 22.8 mm long and 5.4 to 6.0 mm wide (Table 1).

Fig. 4. Droplet of bluish (defense ?) fluid collected on a cuticular spine of a last instar larva of *A. andromacha* (Fabricius) just before pupation. (Scale line = 2 mm).

A rank-sum test of significance (Welkowitz et al, 1976) was undertaken on the data listed in Table 1. The analysis shows a statistically significant difference between the sexes in pupal body length but not in pupal width. For length, the computed z value between male and female pupae is 2.33 (with critical value = 1.96 at the 0.05% level), hence the size differences are significant. However, for width, the computed z value between male and female pupae is 1.13, hence the size differences are not significant at the 0.05% level. No sexual differences in colour pattern were observed in the *A. andromacha* pupae. The length of the pupal stage varied from 7.5 to 10.5 days (Table 2). Comparison of the pupal duration of males and females using the rank-sum test of significance, shows that there was no significant difference between the sexes in time (computed z value = 1.27) at the 0.05% level.

Adult. In the field, adults (mostly females) were common, flying slowly and gracefully in and around vegetation in calm weather. Pairs of butterflies were often observed in copula on twigs and leaves of the host plant. In the laboratory, the newly emerged adults took 10–15 minutes (mean = 12 mins) for the wings to become fully expanded. A dark pink meconium was excreted at about this time. Butterflies spent several hours in resting before leaving their resting posts. A rank-sum test was applied to the size data listed in Table 2. The differences between the sexes in forewing length were significant at the 0.05% level (computed z value = 2.67) but for body length, the differences between the sexes were not significant (computed z value = 0.93).

Most adult emergences (57%) took place during the early hours of the morning (between 2400 and 0400 hrs), while several emergences occurred during 0400 and 0700 hrs (Table 2). Only one female butterfly emerged during the night (2300–2400 hrs) while two emerged during the late morning during daylight hours (Table 2). No butterflies emerged during the period 1200–2300 hrs (Table 2).

Parasites and predators. On 12 Jan. 1985, one pupa of *A. andromacha* was collected from the field which had an unusual orange coloration to it and hence was much darker than the normal pupa. The

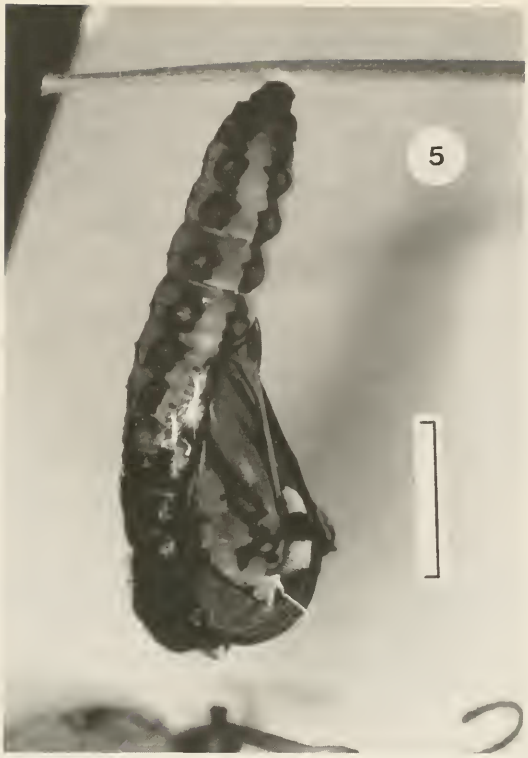

Fig. 5. Adult of *A. andromacha* (Fabricius) about to emerge from the pupa in the laboratory. (Scale line = 5 mm).

Fig. 6. Adult of *A. andromacha* (Fabricius) pinned to show wing markings. (Scale line = 20 mm).

pupa displayed no movement and was rather soft. Four days later, a parasitic fly emerged which was later identified as *Winthemia neowinthemioides* (Townsend) (Diptera: Tachinidae). On 14 Jan. 1985, one last instar larva was collected which possessed three white fly eggs on the body behind the head and one similar egg on one of the forelegs. The larva was collected for later development but died and decayed before pupation could occur and no parasites emerged. On 10 Jan. 1985, a few adult butter-

Table 1. Size measurements of the pupae of *Acraea andromacha andromacha* (Fabricius) bred from field-collected last instar larvae at Brisbane, Queensland during December 1984 to January 1985. (All measurements listed are in mm.)

Sex	Length	Width	Sex	Length	Width
♀	20.5	6.0	♂	19.5	5.5
♀	20.0	6.0	♂	19.0	5.6
♀	22.8	6.0	♂	18.0	5.4
♀	20.0	6.0	♂	19.0	5.6
♀	19.0	5.4	♂	19.0	5.4
♀	21.2	5.5			
♀	20.0	5.5			
♀	20.0	5.5			
♀	19.0	5.5			
Mean	20.3	5.7	Mean	19.1	5.5
S. D.	± 1.2	±0.3	S. D.	± 0.7	±0.1

Table 2. Size, pupal duration and period of emergence of *Acraea andromacha andromacha* (Fabricius) bred from field-collected last instar larvae at Brisbane, Queensland, during December 1984 to January 1985.

Sex	Forewing length (mm)	Body length (mm)	Duration of pupal stage (days)	Emergence	Sex	Forewing length (mm)	Body length (mm)	Duration of pupal stage (days)	Emergence
♀	32.8	23.0	8.5	N	♂	28.2	21.5	8.5	EM
♀	31.0	21.7	8.5	EM	♂	29.0	22.0	9.0	EM
♀	31.0	23.5	8.8	EM	♂	25.0	21.0	9.3	M
♀	30.5	22.7	8.8	EM	♂	29.0	21.5	8.5	EM
♀	30.0	21.2	8.0	M	♂	28.5	21.5	9.0	EM
♀	30.0	20.2	8.8	M					
♀	31.7	21.7	7.5	LM1					
♀	28.5	22.6	8.0	LM2					
♀	30.7	21.0	10.5	EM					
Mean	30.7	21.9	8.6	−−	Mean	27.9	21.5	8.9	−−
S. D.	± 1.2	± 1.1	± 0.8	−−	S. D.	± 1.7	± 0.4	±0.4	−−

Emergence times: N (night) = 2300−2400 hrs; EM (early morning) = 2400−0400 hrs; M (morning) = 0400−0700 hrs; LM1 (late morning, first partim) = 0700−0900 hrs; LM2 (late morning, second partim) = 0900−1200 hrs.

flies were observed feeding from the open flowers of *Leptospermum* sp. (Myrtaceae) at one end of the study site. On one flowering branch one male (?) butterfly had been captured by a large female spider of *Thomisus spectabilis* Doleschall (Araneida: Thomisidae). On 13 Jan. 1985, two *A. andromacha* were observed trapped in a web occupied by an immature female of *Nephila edulis* Koch (Araneida: Argiopidae). The butterflies had been partially wrapped in silk.

Discussion

Acraea andromacha appears to be almost host specific on *Passiflora* vines (Passifloraceae) although the larvae are not able to develop on some introduced, non-native species such as the cultivated passionfruit vine *Passiflora edulis* Sims and the granadilla, *P. quadrangularis* L. (Common & Waterhouse, 1981). It is therefore of interest to note that *P. suberosa*, an introduced species which has become naturalized, is able to support the development of *A. andromacha*. *Passiflora suberosa* appears not to be as toxic to larvae as *P. edulis* or *P. quadrangularis*, for even though many larvae failed to complete development in my labortory studies, a considerable number in the field reach the last instar stage and proceed successfully to adulthood. *P. suberosa* is a previously unrecorded larval host for this butterfly.

Common & Waterhouse (1981) noted that eggs of *A. andromacha* are laid in batches of "about fifty to one hundred" but in my sample, most egg batches were found to contain much less than 50 eggs, the lowest being only 14. The variation in egg numbers/batch found in my sample may be due to the nutrition and size of the adults and whether the adults were disturbed during egg-laying. In the case of low egg numbers, the females may have been caused to take flight and lay eggs elsewhere. Clearly more observations are needed on this aspect to determine the reason(s) for the wide variation observed in the field in egg numbers per batch.

The discharge of droplets of pale bluish-purple defence fluid from the anterior region of the body by the last instar larva is of interest. Examination of the main literature on Australian butterflies shows that there has been no mention of this defensive fluid and I have been unable to obtain any papers or research dealing specifically whith this phenomenon in Australian or exotic butterflies. It is possible that the liquid is toxic to certain vertebrate predators such as birds but unfortunately there have been no direct observations to shed light on its function. No birds were observed in the study site and the only predators seen were spiders (discussed below).

In the laboratory, most of the adult butterflies (44.4 % of females and 80 % of males) emerged in the early morning (i. e. 2400–0400 hrs), while there was a decreasing level of emergence with time, as dawn approached (Table 2). There appear to be no other data on adult emergence times for Australian butterflies so no comparisons can be made at this stage. Early morning emergence in this butterfly may play a significant role in adult survival, e. g. it provides ample time for wing expansion and resting before dawn when diurnal predators become active. However this suggestion must wait further field research to be verified or dismissed.

Little has been recorded on the predators of Australian butterflies (Common & Waterhouse, 1981). For *Acraea andromacha*, Common & Waterhouse (1981) state that this butterfly, the sole Australian representative of the subfamily Acraeinae, is believed to be distasteful (i. e. contains toxic substances) to predators; they also noted that a captive Bearded Dragon lizard *(Amphibolurus barbatus)* was fed an adult *A. andromacha* without any ill effects. In the Brisbane study area, it is unlikely that reptiles play any role in predation of larval or adult butterflies; on the other hand, spiders would appear to be the most important predators of adult *A. andromacha*. Both web-building-spiders (e. g. *Nephila)* and arboreal, non-web-building spiders (e. g. *Thomisus)* were relatively common in two ecological niches in the area and do not appear to show any effects of poisoning by these supposedly toxic butterflies. Presumably, these predatory spiders (like the parasitic flies discussed below) are insensitive to any poisonous substances contained within the bodies of other invertebrates. The food of Australian spiders is also poorly documented but as far as I am aware, this is the first record of *A. andromacha* as prey for *Nephila edulis* and *Thomisus spectabilis* (the latter is known to prey on large, strong-flying cetonid beetles which visit white flowers, Hawkeswood, 1982).

Fly parasitism of Australian butterflies have been of interest to a number of biologists during the past 20 years (e. g. Crosskey, 1973; Smithers, 1973; Hawkeswood, 1980, 1986, 1990; Chadwick & Nikitin, 1985), but the information available is still scanty and there appear to be no previously published host records for *A. andromacha* in Australia. Crosskey (1973), Smithers (1973), Chadwick & Nikitin

(1985) and Hawkeswood (1990) recorded the fly *Winthemia neowinthemioides* (Townsend) (Diptera: Tachinidae) as a parasite of a number of Australian butterflies and moths. Smithers (1973) and Hawkeswood (1990) found that this fly heavily parasitized larvae/pupae of *Danaus plexippus plexippus* (Linnaeus) and *Melanitis leda bankia* (Fabricius), respectively. The data in Hawkeswood (1990) for *M. l. bankia* are from the same site where the material of *A. andromacha* were collected for this present study. However, it is evident that *A. andromacha* larvae were not as heavily parasitized by *W. neowinthemioides* as those of *M. l. bankia* (see Hawkeswood, 1990). It is most likely that the large number of cuticular spines on the *A. andromacha* larvae are more effective in preventing or reducing egg-deposition by the female flies and penetration of newly hatched maggots into the larval cuticle.

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